In Situ Tritium Beta Detector

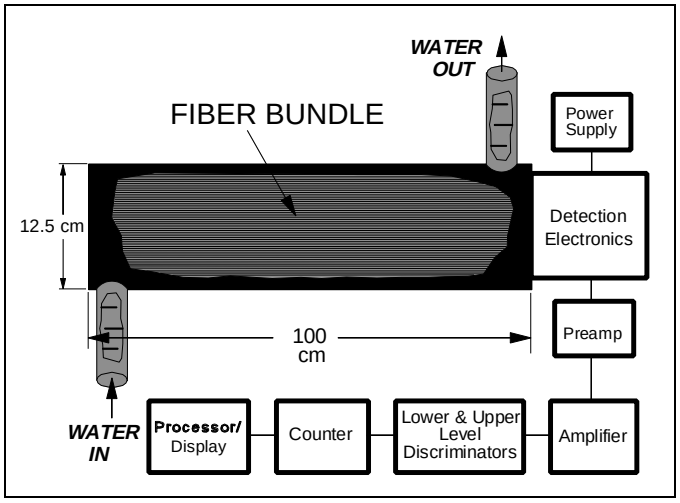
Developer: Babcock & Wilcox, Inc.
Contract Number: DE-AC21-96MC33128
Cross-Cutting Area: CMST

Subsurface Contaminants FOCUS AREA

Problem:

In the Department of Energy (DOE) complex, tritium (^{3}H) is one of the most commonly occurring radionuclide contaminants in ground, surface, and process effluent waters. Monitoring for the presence and activity of ^{3}H must be performed to demonstrate compliance with U.S. Environmental Protection Agency regulations, DOE orders, or other regulations, and to track the movement of tritium contaminated plumes in ground water.

The present approach to ^{3}H measurement is to sample water from a monitoring well and send the sample to a laboratory for analysis, usually with liquid scintillation counting. This analysis method has good detection capability and precision. However, the sampling chain of custody paperwork and lab analysis are labor intensive and expensive, and there is frequently a long analysis turnaround time. Sampling and analysis must be performed at regular intervals to determine if and when changes have occurred, further increasing monitoring costs.



Solution:

The objectives of this project are to design, develop, demonstrate, and deliver a monitoring system capable of detecting and quantifying tritium in situ in ground and surface waters, and in water from effluent lines prior to discharge into waterways. To meet this objective with a system which is faster, and cheaper than currently available methods, target characteristics of the tritium beta detector will include:

- Compact, immersible sensor
- Large wetted sensor surface area
- High sensitivity to ^{3}H
- High specificity to ^{3}H
- Near real-time response
- Rugged, integrated electronics

Benefits:

- Eliminates a significant portion of the time for sampling, chain-of-custody, and laboratory turnaround
- In situ monitoring permits measurements on demand, allowing more frequent measurements and identifying activity changes sooner
- Costs associated with sampling protocols, sampling, chain-of-custody, shipping, and laboratory analysis are significantly reduced
- Likelihood of excursions over release limits is reduced and potential for personnel exposure is reduced

Technology:

The system is based on the detection of the low-energy beta radiation from the radioactive decay of ^{3}H using a special form of scintillating optical fiber directly in contact with the water to be measured. Two types of scintillating fiber will be tested to determine which results in optimum system performance. The first type contains a fluor material in a special cladding configuration which optimizes the absorption of Beta radiation. The second type uses an unbuffered clad fiber with a wavelength shifting fluor in the core and special attention to the selection of the clad material. Laboratory tests will be performed to select the combination of fiber and fluor materials and the fiber configuration which will results in the optimum system design.

The system will consist of an immersible sensor module containing the optical fiber and detection electronics as well as the signal processing electronics. An umbilical cable will be used to interconnect the components. The system will be designed to be permanently installed for routine water monitoring in wells, process lines, and effluent lines, or potentially as a survey tool which can be moved from location to location. The electronics will read out ^{3}H activity directly in units of pCi/L, with straightforward calibration.

Contacts:

Babcock & Wilcox (B&W) has been successful in a number of recent projects for DOE. B&W's Nuclear Environmental Services affiliate brings real world experience and a detailed understanding of waste site operations, remediation activities, and Decontamination & Decommissioning (D&D) activities by virtue of its on-going projects for DOE and its long-term commitment to supply remediation and characterization services to the DOE community.

The Research & Development Division brings innovative technology, sensor development expertise, and a proven track record in the development of radiation monitoring sensors, a post-closure radiation monitoring system, and numerous product developments based on fiber optics. For information regarding this project, the contractor contact is:

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DOE's Morgantown Energy Technology Center supports the Environmental Management - Office of Science and Technology by contracting the research and development of new technologies for waste site characterization and cleanup. For information regarding this project, the DOE contact is:

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